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VISUAL PERCEPTION IN CEREBRAL PALSIED CHILDREN

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ABSTRACT OF THESIS

The purpose of this research was to evaluate the importance of visual perception in the observed difficulty which many brain-injured children experience in the performance of complex visual motor tasks. It was hypothesized that visual perception is not a significant factor in the poor performance of cerebral palsied children on visual-motor tasks.

Thirty cerebral palsied children were given a Multiple Choice Matching Test designed by the investigator. A matched group of thirty normal subjects was given the same test. The cerebral palsied children were significantly poorer in their performance on a test measuring form and pattern discrimination than the non-handicapped group. An analysis of the kinds of errors revealed that cerebral palsied children made significantly more rotational errors than the control group.

This study indicates that impaired visual perception is a significant contributory factor in the inferior performance of cerebral palsied children on a complex visual motor task.

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CHAPTER I

INTRODUCTION

It is a common clinical observation that the intelligence of brain-injured children, as measured by the Stanford-Binet or Wechsler Intelligence Scale for Children, often shows a striking deficit in the performance on visual-motor tasks.(30) Defective performance may be due to visual perceptual inadequacy, visual motor incoordination, or a combination of both. Other more general factors such as impaired attention span or impulsiveness, may also contribute to failure.

The present study grew out of the investigator's experience in the testing of cerebral palsied children for the Society for Crippled Children and Adults of Manitoba. The writer was frequently baffled during the administration of the block design test as to whether a cerebral palsied child's poor performance on this test was due to errors in perception of the presented pattern or errors in execution of a pattern correctly perceived, since the test presents no way of distinguishing between the two types of difficulty. Since it is important to know wherein the difficulty lies, for both practical and theoretical purposes, it was decided to develop a test which could assess the perceptual factor separately from the visual motor without also involving the visual-motor reproduction of it. This study attempts to isolate the visual perceptual factor from the reproduction involved in the block

design test.

A search of the literature revealed a limited number of experimental studies directed toward answering this question of whether a brain-injured subject perceives designs accurately or distorts them in reproduction. The studies of Bortner and Birch (6, 7) using the block designs of the Wechsler tests indicate that brain injured subjects are able to perceive the designs accurately but experience difficulty in the reproduction of the designs. However, it fails to provide conclusive evidence with respect to the separation of perception from perceptual-motor functions.

Theoretically, a more precise method of assessing brain damage in general would facilitate the testing of hypotheses concerning brain functioning. The practical applications of such findings are apparent. In the planning of a learning program it is important to map out the individuals capabilities and limitations accurately with respect to sensory and motor functions. In this way appropriate training can be directed toward his specific individual difficulties.

STATEMENT OF PROBLEM

The problem of this thesis is to evaluate the possible influence of perceptual deficits in children with cerebral

palsy who attempt to solve a complex visual-motor task. More specifically the investigator wished to assess the degree to which a specific perceptual difficulty influenced the cerebral palsied child's performance in the WISC Block Design subtest.

The hypothesis concerning the problem may be stated as follows:

Visual perception is not a significant factor in the poor performance of cerebral palsied children on visual-motor tasks.

The specific hypothesis of this study was as follows:

Errors made on a test of visual perception by a group of cerebral palsy children will not be significantly greater in number than errors made by a comparable group of normal children.

DEFINITION OF TERMS

I. CEREBRAL PALSY

There are numerous definitions of cerebral palsy (C.P.) in the literature. They differ mainly in terms of approach to the problem. Because of the number of associated disorders and their common origin, Denhoff (12) and others propose a more comprehensive "brain damage" syndrome with cerebral palsy as but "one component of a broader brain damage syndrome comprised of neuromotor dysfunction, psychological dysfunction

convulsions and behaviour disorders of organic origin".(12)

A definition which emphasizes the diagnostic aspect and is more restrictive is as follows: "A condition, characterized by paralysis, weakness, inco-ordination, or any other aberration of motor function due to pathology of the motor control centers of the brain." (22)

For the purpose of this study C.P. may be defined as a neuromuscular dysfunction involving paralysis or muscular weakness, involuntary movements and inco-ordination, having as its origin damage to the motor areas of the brain. In addition, associated disorders were found. They included speech and learning deficiencies, mental retardation, sensory disorders, behavioral disturbances and convulsions. The three major types are the spastic, the athetoid and the ataxic. Spastics are characterized by hyper-irritable muscles that may produce contractures and deformities; athetoids are characterized by involuntary purposeless and uncontrollable muscular movements; ataxics are characterized by disturbance in equilibrium. Other types have rigidity, tremor and mixed disabilities, the latter being a combination of the various sub-groups. According to recent estimates by Hopkins, Bice and Colton and Deaver (18, 11) spastics constitute between 46 and 66 percent of the total cerebral palsy population and athetoids constitute between 19 and 24 percent. The prevalence of C.P. has

been recently estimated by Altman (1) as 300 to 350 cases per 100,000.

Ninety percent of all injuries have been estimated to occur either before or during the birth process, with thirty percent prenatal and sixty percent natal. The most important causes of C.P. are birth injuries, maldevelopment of the brain, prematurity and anoxia at the time of birth. Rh incompatibility and toxemia are some of the other identified causes.

2. PERCEPTION

It is not easy to define what is meant by perception. It actually answers the question why things 'look' as they do and why they do not 'look' the same to all individuals. Many stimuli are impinging on our sense organs at any given time. The normal organism selects those to which it will attend and will respond in a unified and coherent fashion. The sense organs and the brain organize a number of stimuli into a larger unit to which the organism may respond in an effective way.

In the normal course of development, we perceive stimuli as wholes, rather than as a succession of discreet stimulations. That is, we respond to an organized perception without analyzing it into parts. It is the relationship of the parts to one another - their integration - that is important. Another characteristic of normal perception is that

the wholes which we perceive are perceived as a figure and a foreground in relief against a background. Our perception is selective and the innumerable simultaneous sensations impinging upon us are not of equal relevance to us.

Perception develops as the organism grows. The young child does not see objects as unitary wholes separated from the rest of the environment. With growth, development and experience, the child's perception is organized into a developing hierarchy of increasingly complex relationships.

Perception, then, is the means by which the individual organizes stimuli which are constantly impinging upon his sense organs and acts as a preliminary to the process of thought.

This study attempts to evaluate the adequacy of visual form perception in cerebral palsied children. For the purpose of this study, visual perception refers to the organization and interpretation of visual stimuli and specifically to the ability to perceive block design patterns accurately.

CHAPTER II

SURVEY OF LITERATURE

There has been an impressive body of literature accumulating in the field of perception of brain-injured children since 1940. However, relatively few published studies were found to deal specifically with the cerebral palsied. It was not found necessary to review all of the research in the several areas of perception as this study deals with a specific aspect of perception, that being the visual difficulty of C.P. children when confronted with tasks involving the perception of form and pattern. It will be recalled that the focus of this study has to do with an attempt to differentiate between the perceptual and the perceptual-motor deficit of C.P, children and therefore special attention will be directed toward those investigators who have pursued this line of inquiry.

GENERAL REVIEW

An account of the early interest in the brain-injured child is available in Strauss and Lehtinen (28). Cruickshank, Bice and Wallen (10) include an excellent review of the research carried out by Strauss and Werner and all the available studies which pertain to perception of the brain-injured up to January 1956.

The pioneer work in the area of perception of brain-

injured children was initiated in 1939 by Strauss and Werner in Racine, Wisconsin. Since that time an ever increasing number of researchers have been attracted to the field of perception. Studies dealing with the visual perception of figure-ground relationships; the production of geometric figures both immediately and from memory; and the perceptual ability to distinguish one entity from another are included in this broad area.

Since the Strauss and Werner experiments provide the basis for much of the later research, it is felt than an elaboration of some of their experiments might help to illustrate the type of research that has been carried out. Strauss and Werner's early efforts concentrated on the figure-ground relationship in visual perceptual tasks. One of the tests they used was a marble board of their own design (38). It consisted of two pieces of cardboard with holes drilled in them. On one board the examiner constructed a pattern out of sight of the subjects. When each pattern had been completed by the examiner, the subject was requested to copy the examiner's pattern on his board. When the subject had completed his copy of the marble board pattern, his board was removed. He was then requested to "draw a picture"(a line drawing in pencil) of the pattern on the examiner's board, with the marble pattern present as a model. The performance of mentally

retarded non-brain-injured children and mentally retarded brain-injured children were compared. The brain-injured group consisted of a number of children whose disabilities, although varying in medical diagnosis, all involved the central nervous system. The results of the marble board test showed that the brain-injured group responded much more frequently to background material than to objects in the foreground and thus had difficulty in the correct reproduction of the designs. Moreover, their attention seemed to flit from one part of the object to another without method so that the resulting product appeared to be disorganized.

Strauss and Werner (36) carried out another experiment which involved purely visual perception of figure-ground relationships. They compared three groups of children, mentally retarded brain-injured children, mentally retarded non-brain-injured children and normal children. A picture test was used which consisted of nine cards on each of which were black and white line drawings of common objects such as a hat, a ship, etc., each of which was embedded in a clearly structured background, consisting of jagged lines, squares, crosses etc. Each picture was exposed tachistoscopically for 1/5 second and the child asked to report what he had seen. Each card was presented twice in succession. The average percentage of back-

ground responses made by normal children was nine percent of all their responses. In the non-brain-injured mentally deficient group, 14 percent were background responses. In the brain-injured group, however, the average percentage of background responses made was 75 percent. This result contrasted sharply with those of normal children and the non-brain-injured mentally deficient children who were able to perceive the object, as opposed to the background.

Strauss and Werner (29) also investigated "perseveration" another frequently mentioned trait of organically damaged children. It is defined as the persistent repetition of an activity once begun. It is a kind of forced responsiveness to stimuli, often occuring after a successful performance has been achieved. One of the three experiments carried out by Strauss and Werner (29) consisted of presenting cards in which were inscribed line drawings of common objects. The subject was required to recognize the objects from a tachistoscopic exposure of 1/5 second. The results showed that the brain-injured group perseverated to a significantly greater degree than the non-brain-injured group.

On a series of tests involving auditory and tactual figure-ground relationships, perceptual disturbances in the nature of more frequent forced responsiveness to the background, distinguished mentally retarded brain-injured children, from

mentally retarded non-brain-injured and normal children. (34, 37).

Sarason (25) has criticized these studies on the basis of the criteria used in the selection of the brain-injured group. He pointed out there is reason to question each of the criteria used or even combinations of them as indicators of brain damage. It seems reasonable, however, to assume that Strauss and Werner's brain-injured defective groups contained more brain-damaged individuals than the non-brain-injured defective groups.

Dolphin (14) undertook a study on the perception of cerebral palsied children in 1950, utilizing C.P. and physically normal children. The I.Q. range of the C.P. group was from 78 to 129 with a mean of 93.46. The statistics for the normal group were similar. His results also indicated that the C.P.. children, as a group, differed from the normal group to a significant degree on several perceptual tasks. This work by Dolphin was the basis for the experiments undertaken by Cruickshank and his associates which culminated in the 1957 publication. (10)

They used as subjects a group of 325 C.P. children, between the ages of 6 to 16, 114 of whom were diagnosed as athetoid and 211 as spastic. They used only C.P. children with Stanford-Binet I.Q.'s of over 75. If Binet I.Q.'s were not available, a judgment of normal intelligence made by school or clinic authorities in conjunction with results of the Stanford-

Binet Vocabulary subtest, was deemed acceptable. All the children had intelligible speech and a minimum mental age of 6 years. All the C.P. children were required to be able to feel a surface and to draw simple geometric figures.

The non-handicapped group was comprised of 110 children and was required to meet the same standards which were used in the selection of the C.P. group. Six perceptual tests were used, many of which were similar to those which had been used in the studies previously outlined. The results confirmed a figure-ground disturbance but led the authors to question whether or not background effects could be considered as important as a general disability in organizing discrete stimuli in accounting for the impaired performance of the C.P. children on perceptual tasks. To quote, "although this study indicates impaired perception in the cerebral palsy children, there appear to be more variables involved than forced responsiveness resulting in the observed figure-ground disturbances. Further research is needed to clarify this latter issue." (10)

Also they found that, although the C.P. groups showed poorer performance on all the tests used, there was no evidence of a general perceptual impairment. That is, although many of the children performed inadequately on two or more of the tests, the majority of them performed inadequately on only one of the tests. Thus it can be seen that the surface

has only been scratched in this whole area of research and many questions are yet to be answered.

Two other instruments which have been used in the testing of brain-injured children, from the aspect of the discovery of perceptual disturbance, are the Bender Visual Motor Gestalt Test and the Ellis Visual Designs Test. Both require the subject to reproduce, with pencil and paper, a series of line drawings of geometric designs.

Bensberg (4) administered the Bender Gestalt test to a group of 161 brain-injured mentally defective children and also to the same number of non-brain-injured mental defectives. The brain-injured children were inferior to the familial mentally retarded children on the reproduction of the figures. There was significantly more reversals, parts repeated, and the use of lines instead of dots in reproductions done by the brain-injured children.

Cassel (8) deviated from the usual administration of the Ellis Visual Designs Test by having subjects reproduce patterns by copying rather than from memory. He pointed out that, when used as a memory test, it was assumed that the child was able to reproduce the design from copy and that the failure was due to memory. He studied brain-injured mentally defective children and familial defective children, reasonably equated for M.A. and C.A. The M.A. ranges were 6.5 to 10.3 years.

The mean chronological ages of these groups were 17.6 and 17.7 and the mean mental ages were 8.3 and 8.0 years respectively. The mean group scores differed beyond the one per-cent level of significance. The brain-injured children displayed marked difficulty in the copying of geometric designs. Cassel then asked the subjects to identify the same designs seen in another context. The brain-injured children were able to identify the designs with almost perfect success and the non-brain-injured group correctly identified all the designs. Thus, Cassel concluded that the relatively low production scores of brain-injured children cannot be explained on the basis of poor memory but must be due to some other factor which limits the ability of the child to express what he has apprehended.

Klapper and Werner (19) compared the performance of three pairs of identical twins; one of each pair was cerebral palsied as a result of birth injury. A number of tests was used including the marble board test and the Bender Gestalt test. In almost all instances performance of the C.P. twin on perceptual tasks was inferior. The small size of the sample is a limitation. Studies of larger samples of twins would prove more enlightening.

SPECIFIC REVIEW

Two studies which employed the block design subtests of the Wechsler tests (6, 7) were directed to answering the question which is of central concern in this study, that is, whether a subject perceives the designs accurately.

Initially Bortner and Birch (6) investigated the ability of brain-injured adults to perceive pattern. The block design subtest of the Wechsler-Bellevue Intelligence Scale - Form I was administered to thirty adult patients who had sustained brain damage late in life. The group consisted of ten left hemiplegics, ten right hemiplegics and ten non-hemiplegic subjects. After the subjects failed to reproduce correct designs, they were asked to choose from actual block assemblies that assembly which looked exactly like the card containing the representation of the block design. The authors concluded that the inability to reproduce designs correctly was not necessarily accompanied by inability to perceive them.

Bortner and Birch (7) recently have published the results of a similar experiment carried out with cerebral palsied children. The block design subtest of the WISC was administered to twenty-eight C.P. children. After the subjects failed to reproduce correct designs, they were asked to match the design on the card with the correct block assemblies. Subjects were given a choice of three actual block assemblies.

These included the correct design, the subject's incorrect solution and an experimentally altered copy. The authors found that despite the inability to reproduce designs the children could discriminate accurately.

These two studies cannot be accepted uncritically because controls were not used. They did not take a comparable group of normal children and give them the same tests. Another limitation is that Bortner and Birch do not control for the transfer of learning from the perceptual-motor task to the perceptual task. Thirdly, the alternative choices are limited.

SUMMARY OF THE LITERATURE

Much of the literature reviewed is not directly related to the present research. There would appear, however, to be no question that brain injury is associated with impaired perception. Areas of impairment include visual motor co-ordination and perceptual differentiation involving figure-ground relationships. With regard to the specific aspect of perception investigated in this thesis only the studies of Bortner and Birch (6, 7) have direct bearing. They, however, fail to provide conclusive evidence with respect to the separation of visual-perceptual from perceptual-motor function in the performance of the block design test.

CHAPTER III

PROCEDURE

The present study was designed to test the ability of cerebral palsied children to discriminate block design patterns accurately. In order to test the hypothesis that visual perception is not a significant factor in the poor performance of cerebral palsied children on visual motor tasks, the following plan was devised. An experimental and a control group consisting respectively of thirty cerebral palsied children and thirty non-handicapped children were established. The control group was selected to be equivalent in terms of intelligence; age and sex to the experimental group. A Multiple Choice Matching Test (Figure I, Appendix) designed to measure visual perception was constructed by the investigator. The test then was administered to the sixty subjects of the total study population. An error score was established and group performances were compared.

SELECTION AND MATCHING OF SUBJECTS

Thirty cerebral palsied children who met the criteria established for selection constituted the experimental group. They were selected from children coming to the Psychology Department of the Society for Crippled Children and Adults of Manitoba for intellectual assessment from May 1961 to March 1962. Many were attending crippled children's classes at Ellen

Douglass School. Twelve of the children in the sample were from rural districts in Manitoba and eighteen were from Greater Winnipeg.

All subjects used in this study were attending school. It was felt that subjects of at least school age should be used in order that the children would understand and be able to complete the test.

The thirty subjects constituting the control group were selected from three Winnipeg district schools and were matched individually to the experimental group on variables of intelligence, age and sex. The nineteen control children from Tuxedo school were members of a higher socio-economic scale than the eleven control children selected from King Edward and Gladstone Schools. The latter schools are in middle class areas. There would seem to be no reason to believe that this variable would influence the performance of children on a test of visual discrimination.

CHILDREN OF THE EXPERIMENTAL GROUP

All thirty children of the experimental group had some neuro-muscular disability and a number had multiple handicaps. All had been diagnosed as patients with cerebral palsy by competent physicians. According to clinical signs, twenty-one were classified as spastic; five as athetoid; one ataxic and

three as mixed C.P.

In addition to the neuromuscular disabilities, associated disorders, including auditory and speech defects, visual and convulsive disorders were found. Four children had convulsive disorders, one had a severe auditory defect, another a severe speech defect and sixteen had visual defects. In regard to visual defects, ten had strabismus, a very common visual disturbance in C.P. children, five had refractive visual defects and one had a combination of both kinds of defects.

With regard to severity of the physical handicap it may be said that sixteen subjects had sufficient involvement to warrant attendance in special classes for the physically handicapped.

The children ranged in age from six to fourteen years and the I.Q.'s ranged from 50 to 119 with a mean I.Q. of 90.6. (Table I)

CHILDREN OF THE CONTROL GROUP

The thirty subjects in this group were selected to match as well as possible the cerebral palsied group in intelligence, age and sex. All children of average intelligence or better had been administered the Otis Quick-Scoring Mental Ability Test by their teachers during the current term. The children of below average intelligence had been tested by psychologists

TABLE I

CHARACTERISTICS OF CEREBRAL PALSY AND NON-HANDICAPPED SUBJECTS

	Cerebral Palsy			Non-handicapped		
Pair No	Sex	C.A.	I.Q.	Sex	C.A.	I.Q.
1	M	6-1	100	M	6-6	107
2	M	6-4	106	M	6-3	108
3	M	6-1	90	M	6-3	100
4	F	6-4	87	F	6-8	100
5	F	6-8	79	F	6-10	82
6	F	6-11	83	F	7-3	85
7	M	7-3	100	M	7-7	106
8	M	8	95	M	7-11	93
9	M	8-6	80	M	8	86
10	M	8-9	95	M	8-3	108
11	F	8-4	119	F	8-4	116
12	F	8-2	82	F	8-7	78
13	M	8-2	113	M	8-7	114
14	M	8-11	100	M	8-10	106
15	F	8-10	102	F	8-9	106
16	F	9-8	104	F	9-6	107
17	M	9-7	62	M	9-8	61
18	M	9-10	95	M	10	98
19	M	10-6	100	M	11	104
20	M	11-4	96	M	10-11	96
21	M	11-4	74	M	11-9	72
22	F	12-10	95	F	12-5	102
23	M	12-4	79	M	11-11	79
24	M	13	69	M	12-8	70
25	M	12	119	M	12	117
26	F	12-7	66	F	12-3	68
27	M	12-11	71	M	12-5	72
28	F	13-9	94	F	13-5	99
29	F	12-7	50	F	13	58
30	F	13-11	113	F	13-11	116
SUM		291.5	2718		291.4	2814
MEAN		9.72	90.6		9.71	93.8

of the Child Guidance Clinic of Greater Winnipeg. They had been tested at various times and tests administered were either the Revised Stanford-Binet-Form L (31) or the WISC (33). The I.Q.'s ranged from 58 to 117 with a mean I.Q. of 93.8. (Table I)

Each subject in the experimental group was paired with a subject in the control group. The results of the pairing can be seen in Table I. In no instance was the chronological age difference between pairs greater than six months. No significant differences in age existed between the groups. ($t=.04, p=.90$) The mean age of the C.P. group was 9.72 and the non-handicapped group 9.71 years respectively. Accuracy of matching was achieved on variables of sex and age but matching on intelligence presented difficulties.

The teachers and principals were not involved in the selection of the group. Only the school principals were informed regarding the purpose of the study.

INTELLIGENCE IS A VARIABLE OF CONCERN

Difficulty was encountered in matching controls and experimental children with respect to intelligence. It would have been desirable to match individuals on the basis of the same intelligence tests. However, this was not possible. It is difficult to test cerebral palsied children on standardized intelligence tests because of their many kinds of handicaps.

It is frequently necessary to use only verbal tests and in case of language or auditory defects, only performance tests.

Matching was accomplished by using I.Q.'s based on a variety of intelligence tests. Whenever available for both groups, verbal ratings were used. This was done because of the large discrepancy in many verbal and performance scores in the cerebral palsied group. This was felt to be justifiable since the experimental task did not involve a motor aspect. Whenever available, I.Q. matchings were based on the verbal score of the WISC. Other tests used, included the Revised Stanford-Binet - Form L,(31) Raven Progressive Matrices - 1947, (23) Nebraska Test of Learning Aptitude for young deaf children (17) and the Otis Quick-Scoring Mental Ability Tests - Alpha and Beta, Form B. (20, 21)

It was difficult to carry out the matching for intelligence and to assess the accuracy of this variable. The difficulties of testing C.P. children, the variety of intelligence tests used in both C.P. and control groups made it difficult to obtain accuracy in matching. It is recognized that matching on a variety of intelligence tests and the adding of I.Q. scores of different intelligence tests is an invalid statistical procedure but in the actual situation it was the best possible way to get a matched group using the available information. The mean I.Q. figures used in this

study must be regarded as estimates.

An analysis of the I.Q. scores would indicate that the non-handicapped group has better intelligence than the C.P. group. This difference, however, is not of statistical significance. The mean I.Q. of the experimental group was 90.6 while that of the control group was 93.8, a difference of 3.2. The characteristics of the children used in this study are described in Table I and Table VII, Appendix. ($t=.737$, $p=.40$)

SELECTION OF TEST

The test for this study was designed by the author. It was selected and modified on the basis of observations made by the investigator at the Society for Crippled Children and Adults of Manitoba. It appeared to the investigator that a number of cerebral palsied children were unable to recognize whether the block design patterns they constructed were correct or not. The reproduction of the block design figures is influenced by perceptual responses and motor action.

Therefore, it was decided to construct a test that would assess the accuracy of visual perception. In other words, the test would be purely visual, without any motor component.

DESCRIPTION OF THE TEST

The test devised for this purpose was based on the block design subtest of the Wechsler Intelligence Scale for Children, (Figure 1, Appendix) which consisted of ten designs, each drawn in red and white upon a separate piece of cardboard. Standard clinical procedure requires that the subject reproduce the design by assembling the blocks. In the adaptation of the block design test that was used in this study, the subject was not required to reproduce the design or pattern. Instead, the subject was presented with a multiple choice task which required him to select the one figure which looked exactly like the original WISC design, from a total of five variants, four of which were incorrect. The four incorrect variants for each design were based on the investigator's observation of incorrect designs that had been produced on the block design subtest by brain-injured children. They consisted of figures which had been rotated, reversed, or otherwise incorrect. (Figure 1, Appendix) The size and color of the patterns were the same as the block design subtest of the WISC.

THE INSTRUCTIONS WERE:

"I am going to show you some patterns. All you have to do each time is point to the pattern which looks exactly like the pattern I put here. Remember only one is right each time."

The cards were laid out in a row before the subject in a specified order, with the stimulus card placed above the row of test cards.

The subject looked at each multiple choice card and made a selection. The investigator recorded the number of the selection chosen and proceeded with the next set of choices and so on until the ten multiple choices were completed.

The scoring procedure was as follows:

The choice was scored correct or incorrect on the appropriate score sheet and the total number of incorrect responses tabulated.

The investigator named the test that was constructed the Multiple Choice Matching Test (M.C.M.T.).

The position of the multiple choice figures was randomized in order to rule out the possibility of differential bias based on preferential positional responses. Location of the correct card in each of the ten sets was selected in such a way that each of the five positions was used twice and none of the correct positions was used twice in succession. The remaining four choices in each set were placed at random in the four remaining positions.

COLLECTION OF DATA

The sixty children in the sample were given the M.C.M.T. by the investigator. The M.C.M.T. was administered in the

investigator's office to the experimental group as the initial test in an assessment battery. The control group was seen individually at their respective schools. In each instance, a short period was used to establish rapport. There was no reason to believe that the total situation was substantially different for either group and would influence performance on a test of visual discrimination. The same examiner administered the test to both groups.

ANALYSIS OF DATA

The experimental and control groups were compared to test the hypothesis concerning differences in visual perception. The types of incorrect choices obtained from each group were also compared. The Wilcoxon Matched-pairs signed-rank test (26, Table A-19, 13) was used to estimate the significance of T. Chi square statistical analysis was used to compare the types of errors.

For the purpose of this study, results were accepted at the .02 level of significance or better. In using the Wilcoxon Matched-pairs signed-ranks test, a two-tailed test was employed.

CHAPTER IV

RESULTS AND INTERPRETATION OF DATA

1. COMPARISON OF GROUPS IN ERROR SCORES ON M.C.M.T.

Error scores obtained on the matching test were used to test the hypothesis concerning differences in cerebral palsied children's ability to perceive form accurately. Table II shows results obtained by matched pairs on the measure of perceptual ability. In the comparison of the scores of individual members of the pairs, it was observed that children in the cerebral palsied group consistently made more errors. There were, however, eleven of the cerebral palsied children who were able to make correct choices.

An analysis of the data in Table II indicated differences between experimental and non-handicapped groups were significant. (P = .01). The null hypothesis stating that there were no significant differences between the C.P. and non-handicapped groups in terms of visual perception is rejected. These findings indicate impaired visual perception in C.P. children as a group.

The findings of this study demonstrate that in brain injured children the ability to discriminate block design pattern is less adequate than in non-handicapped children. Their difficulty in the accurate perception of designs, in turn, would make their block design reproduction incorrect. It

TABLE II

MULTIPLE CHOICE MATCHING TEST SCORES OF THE CEREBRAL PALSY AND NON-HANDICAPPED GROUPS

Pair No	C.P. Error Score	Non-Handicapped Error Score	d	Rank of d	Rank with Less Frequent Sign
1	3	1	2	11.0	
2	4	1	3	16.5	
3	1	1	0	0	
4	0	0	0	0	
5	5	3	2	11.0	
6	5	6	-1	-3.5	3.5
7	1	0	1	3.5	
8	4	2	2	11.0	
9	0	0	0	0	
10	0	0	0	0	
11	2	0	2	11.0	
12	4	4	0	0	
13	2	0	2	11.0	
14	0	0	0	0	
15	0	0	0	0	
16	2	0	2	11.0	
17	6	2	4	18.5	
18	1	0	1	3.5	
19	0	0	0	0	
20	1	0	1	3.5	
21	0	2	-2	-11.0	11.0
22	1	1	0	0	
23	0	2	-2	-11.0	11.0
24	5	2	3	16.5	
25	0	0	0	0	
26	0	0	0	0	
27	6	2	4	18.5	
28	0	1	-1	-3.5	3.5
29	3	1	2	11.0	
30	1	0	1	3.5	
					T = 29

N = 19 P = .005 Two Tailed Test = .01

raises the question with respect to the WISC block design, whether failure to reproduce the designs is due to faulty perception or faulty reproduction. The results are consistent with the findings that have been seen by other investigators (10) in that some brain-injured children show perceptual disturbances while others do not. The results differ from the experiment of Bortner and Birch who concluded that in the majority of instances, cerebral palsied children did discriminate the block design patterns accurately despite inability to reproduce designs. One limitation of the Bortner and Birch study is that they did not control for transfer of learning from the perceptual-motor task to the perceptual task. It is quite possible that this might have accounted for the discrepancy in results.

2. CHARACTERISTICS OF ERRORS

When attention is directed toward the errors in visual choice, it is found that the errors made by the C.P. group were more varied and that rotational errors predominated. Studies to date have not been conclusive, although one of the signs widely held to be most typical of the brain-injured is that of rotation. In the non-handicapped group reversal errors are the most prevalent. Rotations are defined as 90° or 180° angular displacements and reversals as a mirror image.

The errors which were made were categorized. Scoring for type of error was based upon six criteria - reversal, rotation 90°, rotation 180°, fragmented version (incomplete design, open space where continuity is expected), the rotation of one block, otherwise correct, and other errors. Table III shows the error distribution by the above categories. Because there were too few errors in some of the categories to warrant chi square statistical analysis, scores were combined into four classifications - first, reversal; second, the sum of rotations; third, the sum of fragmented and rotation of one block, otherwise correct and fourth, other errors. Table IV shows the error distribution by the combined categories.

TABLE III

CLASSIFICATION OF ERRORS FOR C.P. AND NON-HANDICAPPED GROUPS

Groups	C.P.	Non-handicapped
Reversals	11	14
Rotations 90°	5	3
Rotations 180°	9	1
Rotation of one block, otherwise correct	5	3
Fragmentations	5	1
Other than	22	9
Totals	57	31

TABLE IV

CLASSIFICATION OF ERRORS FOR C.P. AND NON-HANDICAPPED GROUPS COMBINED INTO FOUR CATEGORIES

Groups	C.P.	Non-handicapped
Reversals	11	14
Rotations 90° and 180°	14	4
Rotation of one block, otherwise correct and fragmentations	10	4
Other than	22	9
Totals	57	31

$x^2 = 6.846$ sig = .10

There was no overall difference in the classifications of errors for C.P. and non-handicapped groups. (P = .10)

Two specific types of errors, that of total rotational errors and reversals are considered separately and subjected to chi square statistical analyses. Reversal errors are not significantly differentiated. (chi square .36, p=70) but there are significantly more rotational errors among C.P. children (chi square 5.56, p = .02).

I.Q. AS A FACTOR

The relation between I.Q. and errors is of some importance since the mean I.Q. of the control group was slightly higher than the experimental group. An examination of Table V and Tables IX to XII, Appendix, reveal that intelligence and

the making of errors in the M.C.M.T. are not related for C.P. children, but there is a tendency for the I.Q.'s of those children of the normal group who had no errors to be higher than those who did make errors. The significance of this finding is not altogether clear to the writer. It does suggest that intelligence relates to the error score for normal children. This may have influenced the results to some extent in favor of non-handicapped children making fewer errors since they were of slightly higher I.Q. However, it is unlikely that a mean difference of I.Q. of 3.2 between the two groups would be sufficiently large to account for the difference in performance in the M.C.M.T.

TABLE V

COMPARISON OF MEAN I.Q.'S OF C.P. AND NON-HANDICAPPED SUBJECTS MAKING ERRORS AND NOT MAKING ERRORS ON M.C.M.T.

Group	C.P.		Non-handicapped	
	Making Errors N=19	Not making errors N=11	Making Errors N=15	Not making errors N=15
	I.Q. 90.6	I.Q. 90.5	I.Q. 84.4	I.Q. 103.2
	t = ,015	p =.90	t = 3.50	p = .01

VISUAL ACUITY AS A FACTOR

The visual status of our brain-injured and normal groups was not equivalent. Many C.P. children wore glasses and had had operations to correct visual defects. In order to assess the possible influence of the visual acuity variable, the investigator separated out the C.P. children who had visual defects. This was done by an examination of medical reports on the Society files of each of the C.P, children. Table VI shows the distribution of errors in the C.P, group with visual defects and without visual defects.

TABLE VI

COMPARISON OF ERROR SCORE OF C.P. SUBJECTS HAVING VISUAL DEFECTS AND THOSE HAVING NO VISUAL DEFECTS

Visual Status	No. of C.P. Subjects	Error Score
No visual defects	14	27
Visual defects	16	30
Totals	30	57

The data would indicate that visual acuity is not related to the error score. (chi square .16, p=.70)

COMPARISON OF BLOCK DESIGN SCORES OF C.P. CHILDREN MAKING ERRORS AND C.P. CHILDREN NOT MAKING ERRORS

An examination of Table VII would indicate the relation between block design scores of C.P. children making errors and C.P. children not making errors on the M.C.M.T.(Table XIII, Appendix shows the scores on which this is based). However, this difference was not statistically significant.($t=.385$, $p= .70$) This suggests the possibility that C.P. children may have difficulty in block design either from perceptual factors or from other factors, possibly motor, which result in faulty reproduction of designs. However, it should be noted that analysis is based on a small number of cases and these results are only suggestive.

TABLE VII

COMPARISON OF MEAN BLOCK DESIGN SCORES OF C.P. CHILDREN MAKING ERRORS AND C.P. CHILDREN NOT MAKING ERRORS ON M.C.M.T.

C.P. not making errors N=7	C.P. making errors N=12
mean score = 8.50	mean score = 7.42

ADDITIONAL OBSERVATION

A factor which could not be controlled with respect to test performance was that of the attention span. Watching

these children, it was apparent that many of the cerebral palsied children and some normal children had difficulty in sustaining attention. There were occasions in which the investigator was uncertain whether the child could see the correct relationship or just did not try. Nevertheless, attention was a variable that could not be measured.

CHAPTER V

SUMMARY AND CONCLUSIONS

This study was designed to investigate the effect of the adequacy of visual perception of form and pattern in a visual-motor task by brain-injured children. An experiment was designed to test the hypothesis that faulty visual perception is not a significant factor in the impaired performance of cerebral palsied children in carrying out visual motor tasks.

Two groups of thirty children, an experimental group diagnosed as C.P. and a non-handicapped control group, ranging in ages from six to fourteen years were tested. Groups were matched on the following variables; sex, age and intelligence. Visual perception was measured by a test of form discrimination constructed by the investigator. Data were collected and analyzed by employing Wilcoxon's Matched-pairs signed-ranks test. As a result of this investigation the following findings were revealed:

(1) The comparison of group performances of C.P. and normal children in visual perception of form and pattern showed significant differences. The C.P. group made significantly more errors than the normal group.

(2) A number of C.P. children made no errors and showed no deficiency in visual perception. The problem of individual differences can be appreciated in working with C.P. children.

(3) Errors of the C.P. group were more varied and rotational errors were predominant. A breakdown of rotational errors revealed more 180° rotational errors than 90° rotations.

In the normal group there was a suggestion that there were more reversals. However, this was not significant. The relation of other kinds of errors was not significantly differentiated.

The data as they were collected and treated indicate that cerebral palsied children perform less adequately on a task of visual perception of form than do normal children. Thus, the hypothesis underlying this investigation is rejected. Therefore, it may be stated in terms of this study, that C.P. children have less adequate ability than non-handicapped children to discriminate perceptually.

Although this study indicates impaired perception in C.P. children, there appear to be more variables involved than the ability to perceive designs accurately. These findings leave some questions unanswered and further research is required to clarify some of the apparent inconsistencies. The question arises whether more general factors, such as impaired attention span may be important.

RECOMMENDATIONS

This experiment was set up to determine whether or not C.P. children were able to perceive accurately the block

design patterns of the WISC. Further research of this nature could achieve a more statistically accurate matching of intelligence of experimental and control groups. This might be achieved by excluding C.P. children with certain kinds of handicaps, such as severe auditory, speech and language defects.

The results of this study indicated that C.P, children made significantly more rotational errors and suggested that errors were more varied in kind. There was some suggestion that the normal group made more reversal errors. A more thorough investigation of the nature of errors, using a larger sampling could be profitably undertaken. A task similar to the one used in this study might be devised which would make it possible to classify errors more easily. This could be accomplished by making block design patterns which would lend themselves to reversal, rotation or other kinds of errors to be investigated more consistently than the patterns used in this study.

It might be worthwhile to test the hypothesis that certain kinds of errors such as reversals or rotations are due to insufficient attention being given to the task or to haste in execution. If a means of controlling attention could be devised this would be an area of further study.

An interesting area for research would be using training

techniques to modify perception areas that are deficient in functioning in brain-injured children. For example, training in form perception at certain ages would prove to have educational implications.

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APPENDIX

FIGURE 1.

MULTIPLE CHOICE MATCHING TEST

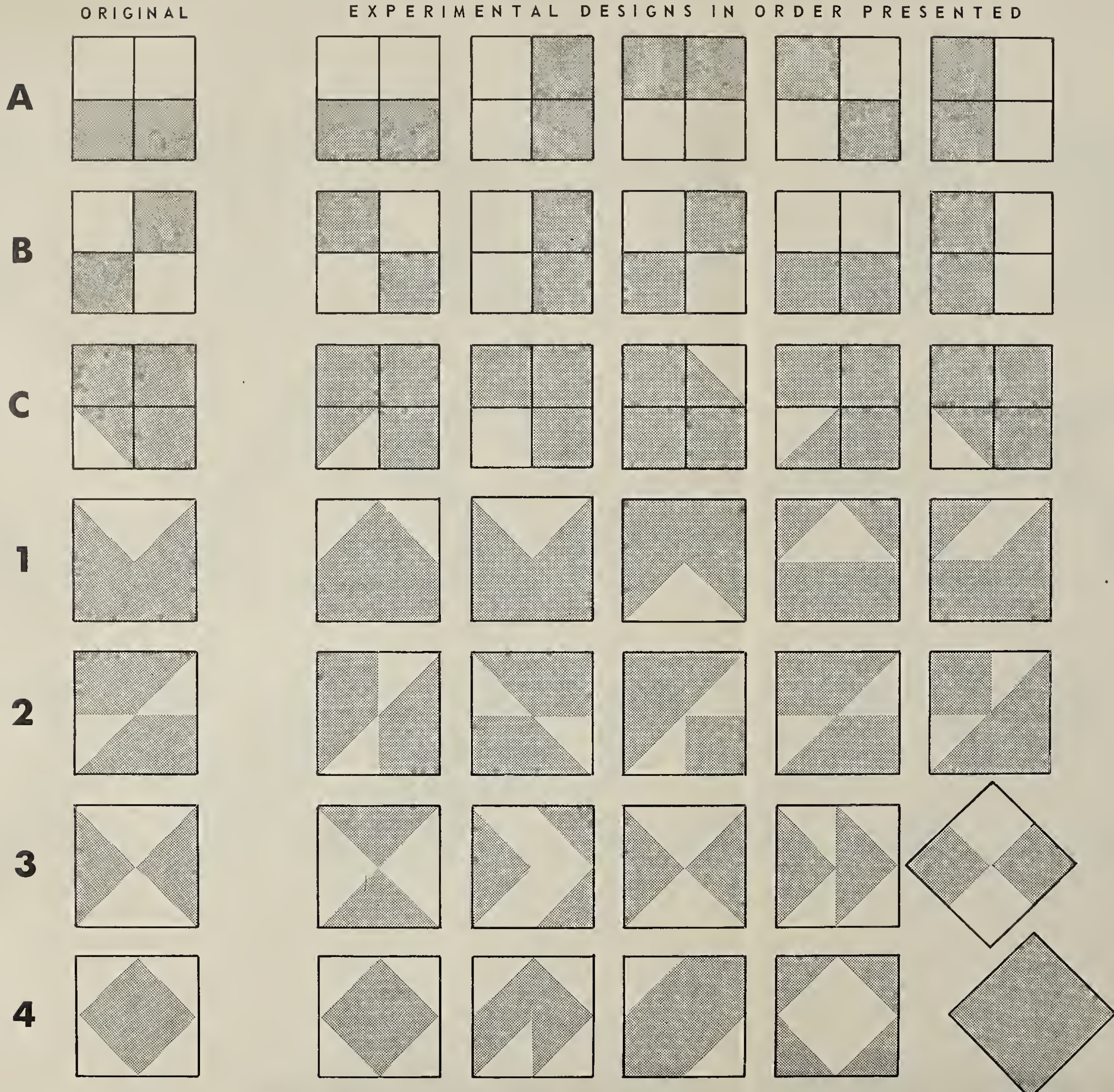

FIGURE 1. (continued)

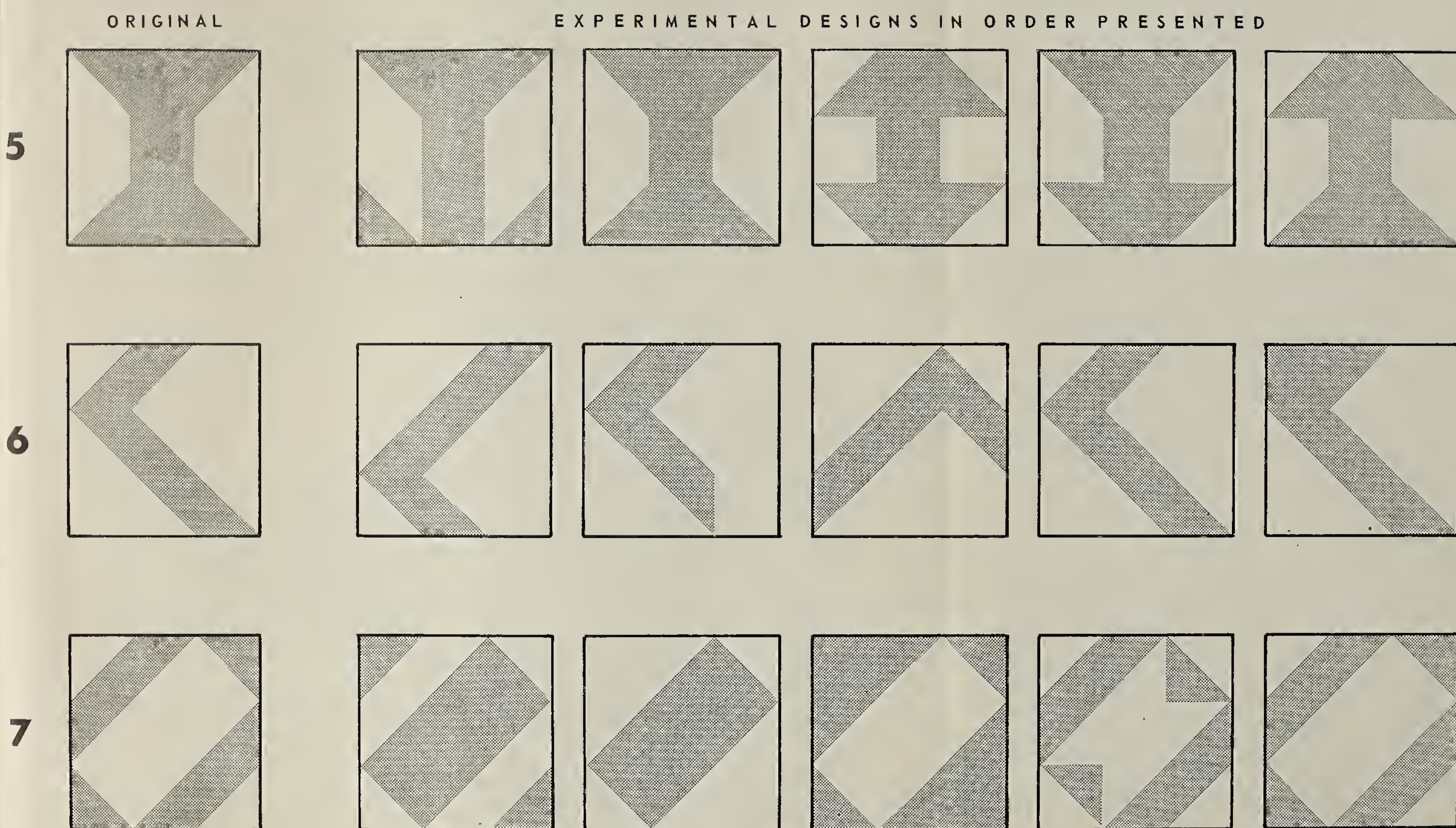

TABLE VIII

CHARACTERISTICS OF CEREBRAL PALSY AND NON-HANDICAPPED SUBJECTS

	CEREBRAL PALSIED				NON-HANDICAPPED			
Pair No	Sex	C.A.	I.Q.	NAME OF TEST	Sex	C.A.	I.Q.	NAME OF TEST
1	M	6-1	100	Nebraska Test	M	6-6	107	OTIS-Alpha B
2	M	6-4	106	Stanford-Binet	M	6-3	108	OTIS-Alpha B
3	M	6-1	90	Stanford-Binet	M	6-3	100	OTIS-Alpha B
4	F	6-4	87	Stanford-Binet	F	6-8	100	OTIS-Alpha B
5	F	6-8	79	Stanford-Binet	F	6-10	82	Stanford-Binet
6	F	6-11	83	Stanford-Binet	F	7-3	85	Stanford-Binet
7	M	7-3	100	Stanford-Binet	M	7-7	106	OTIS-Alpha B
8	M	8	95	(approx.) Raven-1947	M	7-11	93	OTIS-Alpha B
9	M	8-6	80	V.I.Q. WISC	M	8	86	V.I.Q. WISC,OTIS
10	M	8-9	95	V.I.Q. WISC	M	8-3	108	OTIS-Alpha B
11	F	8-4	119	Stanford-Binet	F	8-4	116	OTIS-Alpha B
12	F	8-2	82	V.I.Q. WISC	F	8-7	78	Stanford-Binet
13	M	8-2	113	V.I.Q. WISC	M	8-7	114	OTIS-Alpha B
14	M	8-11	100	Stanford-Binet	M	8-10	106	OTIS-Alpha B
15	F	8-10	102	Stanford-Binet	F	8-9	106	OTIS-Alpha B
16	F	9-8	104	V.I.Q. WISC	F	9-6	107	OTIS-Alpha B
17	M	9-7	62	Stanford-Binet	M	9-8	61	Stanford-Binet
18	M	9-10	95	V.I.Q. WISC	M	10	98	OTIS-Alpha B
19	M	10-6	100	V.I.Q. WISC	M	11	104	OTIS-Beta B
20	M	11-4	96	Stanford-Binet	M	10-11	96	OTIS-Beta B
21	M	11-4	74	V.I.Q. WISC	M	11-9	72	V.I.Q. WISC
22	F	12-10	95	V.I.Q. WISC	F	12-5	102	OTIS-Beta B

continued

TABLE VIII CONTINUED

	CEREBRAL PALSIED				NON-HANDICAPPED			
Pair No	Sex	C.A.	I.Q.	NAME OF TEST	Sex	C.A.	I.Q.	NAME OF TEST
23	M	12-4	79	V.I.Q. WISC	M	11-11	79	V.I.Q. WISC
24	M	13	69	V.I.Q. WISC	M	12-8	70	V.I.Q. WISC
25	M	12	119	V.I.Q. WISC	M	12	117	OTIS-Beta B
26	F	12-7	66	V.I.Q. WISC	F	12-3	68	Stanford-Binet
27	M	12-11	71	Stanford-Binet	M	12-5	72	V.I.Q. WISC
28	F	13-9	94	V.I.Q. WISC	F	13-5	99	OTIS-Beta B
29	F	12-7	50	V.I.Q. WISC	F	13	58	Stanford-Binet
30	F	13-11	113	V.I.Q. WISC	F	13-11	116	OTIS-Beta B
Sum		291.5	2718			291.4	2814	
Mean		9.72	90.6			9.71	93.8	

V.I.Q. WISC	Verbal I.Q. - Wechsler Intelligence Scale for Children
Stanford-Binet	Revised Stanford-Binet Form L.
Raven - 1947	Raven Progressive Matrices - 1947.
Nebraska	Nebraska Test of Learning Aptitude for Young Deaf Children
OTIS	Otis Quick-Scoring Mental Ability Test-Alpha and Beta-Form B.

TABLE IX

CHARACTERISTICS OF CEREBRAL PALSY SUBJECTS WITH ERRORS

Pair No	Sex	C.A.	I.Q.	Error Score
1	M	6-1	100	3
2	M	6-4	106	4
3	M	6-1	90	1
5	F	6-8	79	5
6	F	6-11	83	5
7	M	7-3	100	1
8	M	8	95	4
11	F	8-4	119	2
12	F	8-2	82	4
13	M	8-2	113	2
16	F	9-8	104	2
17	M	9-7	62	6
18	M	9-10	95	1
20	M	11-4	96	1
22	F	12-10	95	1
24	M	13	69	5
27	M	12-11	71	6
29	F	12-7	50	3
30	F	13-11	113	1
Sum		177.67	1722	57
Mean		9.25	90.6	

TABLE X

CHARACTERISTICS OF CEREBRAL PALSY SUBJECTS WITHOUT ERRORS

Pair No	Sex	C.A.	I.Q.	Error Score
4	F	6-4	87	0
9	M	8-6	80	0
10	M	8-9	95	0
14	M	8-11	100	0
15	F	8-10	102	0
19	M	10-6	100	0
21	M	11-4	74	0
23	M	12-4	79	0
25	M	12	119	0
26	F	12-7	66	0
28	F	13-9	94	0
Sum		113.83	996	
Mean		10.3	90.5	

TABLE XI

CHARACTERISTICS OF NON-HANDICAPPED SUBJECTS WITH ERRORS

Pair No	Sex	C.A.	I.Q.	Error Scores
1	M	6-6	107	1
2	M	6-3	108	1
3	M	6-3	100	1
5	F	6-10	82	3
6	F	7-3	85	6
8	M	7-11	93	2
12	F	8-7	78	4
17	M	9-8	61	2
21	M	11-9	72	2
22	F	12-5	102	1
23	M	11-11	79	2
24	M	12-8	70	2
27	M	12-5	72	2
28	F	13-5	99	1
29	F	13	58	1
Sum		146.83	1266	31
		9.79	84.4	

TABLE XII

CHARACTERISTICS OF NON-HANDICAPPED SUBJECT
WITHOUT ERRORS

Pair No	Sex	C.A.	I.Q.	Error Scores
4	F	6-8	100	0
7	M	7-7	106	0
9	M	8	86	0
10	M	8-3	108	0
11	F	8-4	116	0
13	M	8-7	114	0
14	M	8-10	106	0
15	F	8-9	106	0
16	F	9-6	107	0
18	M	10	98	0
19	M	11	104	0
20	M	10-11	96	0
25	M	12	117	0
26	F	12-3	68	0
30	F	13-11	116	0
Sum		144.58	1548	
Mean		9.64	103.2	

TABLE XIII

BLOCK DESIGN SCORES OF C.P. CHILDREN MAKING ERRORS AND NOT MAKING ERRORS ON THE M.C.M.T.

C.P. Group Without Errors on M.C.M.T.	C.P. Group with Errors on M.C.M.T.
Raw Scores Block Design	Raw Scores Block Design
8	5
3	5
3	18
6	12.5
19.5	4
6	18
14	5
	0
	6
	7.5
	6
	2
M = 8.50	M = 7.42

TABLE XIV

SUMMARY OF SCORE SHEETS: RESULTS OF CEREBRAL PALSY SUBJECTS ON THE MULTIPLE CHOICE MATCHING TEST

Subject No	Number of block design patterns 1-10										Error Score
	1	2	3	4	5	6	7	8	9	10	
1	*1	3	5	2	1X	3	1	2	2X	3X	3
2	1	3	3X	2	2X	3	3X	2	2X	5	4
3	1	3	4X	2	4	3	1	2	4	5	1
4	1	3	5	2	4	3	1	2	4	5	0
5	2X	1X	3X	2	4	3	5X	2	1X	5	5
6	1	1X	5	2	2X	3	5X	3X	4	4X	5
7	1	3	5	2	1X	3	1	2	4	5	1
8	1	3	3X	2	2X	3	5X	2	1X	5	4
9	1	3	5	2	4	3	1	2	4	5	0
10	1	3	5	2	4	3	1	2	4	5	0
11	1	3	5	2	1X	1X	1	2	4	5	2
12	1	1X	3X	2	2X	3	1	2	3X	5	4
13	1	3	5	2	4	5X	1	2	2X	5	2
14	1	3	5	2	4	3	1	2	4	5	0
15	1	3	5	2	4	3	1	2	4	5	0
16	1	3	4X	2	1X	3	1	2	4	5	2
17	1	1X	1X	3X	1X	3	1	2	2X	3X	6
18	1	3	5	2	4	3	1	2	2X	5	1
19	1	3	5	2	4	3	1	2	4	5	0
20	1	3	5	2	4	3	1	3X	4	5	1
21	1	3	5	2	4	3	1	2	4	5	0
22	1	3	5	2	1X	3	1	2	4	5	1
23	1	3	5	2	4	3	1	2	4	5	0
24	3X	3	3X	3X	2X	1X	1	2	4	5	5
25	1	3	5	2	4	3	1	2	4	5	0
26	1	3	5	2	4	3	1	2	4	5	0
27	4X	3	1X	1X	4	1X	1	1X	4	3X	6
28	1	3	5	2	4	3	1	2	4	5	0
29	1	3	5	2	1X	3	1	2	5X	3X	3
30	1	3	5	3X	4	3	1	2	4	5	1
Errors	3	4	9	4	12	4	4	3	9	5	57

* Numbers in the body of the table indicate the number of the selection chosen by the subject for specific block design patterns.

X Error

TABLE XV

SUMMARY OF SCORE SHEETS: RESULTS OF NON-HANDICAPPED SUBJECTS ON THE MULTIPLE CHOICE MATCHING TEST

Subject No	Number of block design patterns 1-10										Error Score
	1	2	3	4	5	6	7	8	9	10	
1	* 1	3	5	2	4	3	1	2	4	3X	1
2	1	3	5	2	4	3	5X	2	4	5	1
3	1	3	5	2	2X	3	1	2	4	5	1
4	1	3	5	2	4	3	1	2	4	5	0
5	1	1X	1X	2	2X	3	1	2	4	5	3
6	1	1X	1X	2	1X	1X	1	2	1X	3X	6
7	1	3	5	2	4	3	1	2	4	5	0
8	1	3	5	2	2X	3	5X	2	4	5	2
9	1	3	5	2	4	3	1	2	4	5	0
10	1	3	5	2	4	3	1	2	4	5	0
11	1	3	5	2	4	3	1	2	4	5	0
12	1	1X	5	2	1X	3	1	1X	1X	5	4
13	1	3	5	2	4	3	1	2	4	5	0
14	1	3	5	2	4	3	1	2	4	5	0
15	1	3	5	2	4	3	1	2	4	5	0
16	1	3	5	2	4	3	1	2	4	5	0
17	1	3	3X	2	4	3	1	2	1X	5	2
18	1	3	5	2	4	3	1	2	4	5	0
19	1	3	5	2	4	3	1	2	4	5	0
20	1	3	5	2	4	3	1	2	4	5	0
21	1	1X	5	2	5X	3	1	2	4	5	2
22	1	3	5	2	4	1X	1	2	4	5	1
23	1	1X	5	2	4	3	1	2	1X	5	2
24	1	3	5	2	2X	3	1	2	5X	5	2
25	1	3	5	2	4	3	1	2	4	5	0
26	1	3	5	2	4	3	1	2	4	5	0
27	1	3	5	2	4	3	5X	2	2X	5	2
28	1	3	5	2	2X	3	1	2	4	5	1
29	1	3	5	2	4	3	1	2	3X	5	1
30	1	3	5	2	4	3	1	2	4	5	0
Errors	0	5	3	0	8	2	3	1	7	2	31

* Numbers in the body of the table indicate the number of the selection chosen by the subject for the specific block design patterns.

X Errors